THURSDAY, AUGUST 10, 1899.

## *FLORAS FROM THE ROYAL GARDENS, KEW.*

*Flora Capensis: being a Systematic Description of the Plants of the Cape Colony, Caffraria, and Port Natal (and Neighbouring Territories), by various Botanists.* Edited by W. T. Thiselton-Dyer, C.M.G., C.I.E., LL.D., F.R.S., &c., Director, Royal Gardens, Kew. Published under the authority of the Governments of the Cape of Good Hope and Natal. Vol. VI. Hæmodoraceæ to Liliaceæ. Vol. VII., Parts I. and II. Pontederiaceæ to Gramineæ. (London: Lovell Reeve and Co., 1896-97.)

*Flora of Tropical Africa.* Edited by W. T. Thiselton-Dyer, C.M.G., C.I.E., LL.D., F.R.S., &c., Director, Royal Gardens, Kew. Vol. VII. Hydrocharideæ to Liliaceæ. Published under the authority of the First Commissioner of Her Majesty's Works and Public Buildings. (London: Lovell Reeve and Co., Ltd., 1898.)

IT should not be necessary at this time of day to emphasise the fact of the imperial character of the Royal Gardens, Kew, still it would appear there are many inhabitants of Great Britain whose notion of the value of this establishment is limited by their desire for a local public park suited to the recreation of dwellers in and about London. Several incidents have of late shown this—witness the recent preposterous proposal brought forward in the House of Commons to throw the gardens open to cyclists! Suggestions of this kind are on the face of them, to those aware of the true character of the gardens, too absurd for discussion, yet there is an element of danger in this appeal to the selfish instincts of that large body of pleasure-seekers who are veritable Gallios in their contempt for science, especially when its just claims place an obstacle to the gratification of their pleasure whims. It is hardly conceivable that any First Commissioner of Works—and he is the Minister responsible for the gardens—would ever assent to such modification of the traditional character of the gardens as concession to the demand above referred to, which may be taken as symptomatic of a craze, would mean; yet in these days of political opportunism, and with a prospect of its even greater development, the preservation of the noble heritage the nation possesses in the Kew of the present becomes a question not altogether free from anxiety in the minds of those who know the services Kew renders and is capable of yet rendering to the Empire. Perhaps the surest way of avoiding disaster in the future is by making known far and wide what are its real functions and how they are discharged, for through the education of public opinion alone can an effective checkmate be given to any movement destined to sacrifice the scientific features of Kew at the altar of popular pleasure.

It is not the intention to discuss here the whole of the functions that belong to and are discharged by Kew—its value as an unrivalled microcosm of the vegetation of the world, its example as a school of horticultural practice, its position as a training ground for young gardeners, its use as an index of the products of the vegetable kingdom and as a nursery and centre of distribution of economic plants for the benefit of our Colonies—but to direct attention to the continued progress, indicated by the titles of the volumes cited above, of the large undertaking to which the energy and foresight of its first Director, Sir William Hooker, committed Kew—namely, the issue of a "Series of Floras" under the authority of the Home or Colonial Governments. Botanists are familiar with what has been already done by Kew towards the carrying out of this programme. The Australian Flora by Bentham and Von Mueller, that of Hong Kong by Bentham, of New Zealand by Dr. Hooker, of Mauritius and the Seychelles by Baker, of the West Indies by Griesbach, and the recently completed British Indian Flora by Sir Joseph Hooker are a tribute alike to the industry and talent of the botanists who have taken part in their production and to the importance of Kew in focussing botanical knowledge, as well as to the labours of our countrymen in the exploration of regions opened up to our occupation. The appearance of the volumes mentioned above has been particularly welcome, inasmuch as they denote a renewal of progress after a pause. The Flora Capensis was arrested after the publication of the third volume in 1865 by the death of Harvey, who, with Dr. Sonder, was its principal author; and of the Flora of Tropical Africa, the last of the three volumes brought out by Prof. Oliver appeared in 1877. The Director of Kew is to be congratulated upon having surmounted the hindrances which have contributed to the delay in continuing these Floras, and he will, it may be hoped, be encouraged to contend with and overcome all obstacles that may as it seems, threaten a steady advance to the conclusion of the works.

The volumes and parts before us are not in sequence with the volumes that have already appeared. As Sir William Thiselton-Dyer points out, once the plan of a work of the kind is settled it is immaterial what part first appears, and he has exercised a wise discretion in giving early attention to those groups of plants which are abundantly represented in our gardens, and which have consequently compelled special attention on the part of members of the Kew staff. The Monocotyledons have been therefore selected for first treatment in the resumed work upon the Floras, and we have the benefit of the ripe experience of Mr. Baker in the elucidation of the Liliaceæ, Irideæ, Amaryllideæ and allied orders, which are so popular in horticulture and form so large an element of the plant-life of South Africa, and to a less extent in the area embraced within the scope of the Tropical African Flora; Mr. Rolfe brings to the enumeration and description of the Tropical African Orchideæ a rare knowledge of the order; and Mr. N. E. Brown describes the Tropical African species of Disa as an expert. Tropical African Hydrocharideæ have fallen to the share of Mr. C. H. Wright, and the Cyperaceæ of South Africa find a sound critical exponent in Mr. C. B. Clarke; the account of the Gramineæ of the same area is in the able hands of Dr. Stapf, and should be completed in the next part of the Flora, for which we trust we shall not have long to wait.

In the continuations of these Floras we have the same standard of excellence to which preceding volumes have accustomed us, and which we therefore look for in publications coming from Kew. Their issue will be a boon not only to the professed botanical world, but also to all those who are interested in the many plants now known in, and still coming into cultivation from, Africa; and they should give a great stimulus to the further investigation of the vegetation of Africa and to the introduction of interesting and beautiful plants to the horticulture of the world.

No one looking at these volumes can fail to notice that their production at Kew, where a collection of living plants in a garden is associated with one of dried specimens in a herbarium, gives additional value to them. The necessity of the latter as a guide to the accurate determination of the nomenclature in a scientific garden is apparent; the service of the former as an adjunct to the herbarium by affording means for the study of the living plants in cases where the dried specimen can seldom be satisfactory is clearly brought out in the account of the groups of succulent monocotyledons treated of in these Floras. If all descriptive botanists were able, as is possible at Kew, to look at the dry bones of the plants with which they deal with some consideration of the form that clad them when alive, we should be spared much of that prolific synonymy which is the bane of the systematist. It is the possession of the finest collection of living plants along with a like one of dried specimens, through which it can contribute as in these Floras to the advance of our knowledge of the vegetation of the globe, that gives Kew an absolutely unique position as the leading botanical institution of the world, a position it has achieved in little over fifty years through the scientific ability and remarkable administrative capacity of its successive Directors, Sir William Hooker, Sir Joseph Hooker, and Sir William Thiselton-Dyer.

## STATISTICAL METHODS APPLIED TO BIOLOGY.

*Die Methode der Variationsstatistik.* Von Georg Duncker. Pp. 75, with 8 figures in text. (Leipzig: Wilhelm Engelmann.)

THIS pamphlet, a reprint from the *Archiv für Entwickelungsmechanik*, is an attempt to render the formulæ and results of the statistical method somewhat more accessible to German biologists than they are, for example, in Prof. Karl Pearson's original papers. In the first part a complete outline is given of the fitting of frequency curves, normal or skew, to observed statistics, and in the second part a similar outline of the theory of correlation. The whole of this extensive ground is covered, however, in some sixty octavo pages, necessitating a degree of compression too great for satisfactory results. Proofs are necessarily almost wholly omitted, several difficulties likely to occur to beginners are slurred over, and there is more than one absolute blunder.

If $y = \phi(x)$ be any frequency curve, the frequency of deviations lying between $x - \frac{1}{2}c$ and $x + \frac{1}{2}c$ is given by the integral of the frequency-function $\phi(x)$ between those limits. If, and only if, $c$ be very small, we may replace this integral by the product $y.c$ to a close degree of approximation. Hence, in any practical case of recording the distribution of frequency where we have to choose an arbitrary unit of grouping $c$, this should always be made as small as possible. If this be done, and if the number of observations be large, the observed frequency polygon closely approximates to a continuous curve, and the element of area round any ordinate differs very slightly from $y.c$. Moreover, the process of obtaining the moments of the observed frequency polygon by treating the observed frequencies as isolated loads, then differs very slightly in result from the process of continuous integration by which the moments of the theoretical curve were calculated. But if the element of grouping be not small, the element of area round $y$ may differ very sensibly from $y.c$, and the process of calculating moments by treating group frequencies as isolated loads is not even a rough approximation to continuous integration. Hence Prof. Pearson's original preference of the moments of the trapezia system (*Phil. Trans.* A, 1895, "On Skew Variation," &c.), and Mr. W. F. Sheppard's papers on moment calculation (*Proc. Lond. Math. Soc.*, vol. 29, and *Journal Roy. Statistical Soc.*, vol. 60, 1897). This difficulty, due to the grouping, is entirely passed over by Herr Duncker. A series of observations giving only five base elements $c$ is fitted without remark to a normal curve (Fig. 2). In every case the ordinates of the fitted curve are calculated only for the abscissæ of the observed ordinates, their tops are joined up, and the polygon so obtained called the "theoretical frequency polygon," as in Figs. 1, 2, 3—a procedure of somewhat dubious use in any case, and quite illegitimate where the elements are as large as in Fig. 2. If the author had not missed this fundamental point he would not, perhaps, have been so puzzled by Prof. Pearson's use of first one and then another method of calculating moments. It is a pity that all the arithmetical examples given of fitting frequency curves refer to cases of discontinuous variation, as these are naturally the material least suitable for representation by continuous curves.

There seems a corresponding lack of clearness in some fundamental points of the theory of correlation. The various formulæ for correlation coefficient, regressions, &c., are given, but the author nowhere clearly points out their meanings and limitations in cases of non-normal correlation. It is not noted that for complete independence the condition $r = o$ is, in general, necessary but *not sufficient*. The values of partial correlations are given, but it is not noted that only in normal correlation (so far as we know) is the partial correlation the same for every array. The correction given on p. 48 for reducing the product sum about an arbitrary pair of axes to the product sum about the mean is surely absolutely wrong; the different sums given are all of different dimensions. If $S_0$ be the value of the sum for axes through the mean, $S_1$ its value for the arbitrary axes

$$S_0 = S_1 - N.\,\bar{x}\,\bar{y},$$

where N is the number of observations and $\bar{x}\,\bar{y}$ are the coordinates of the mean with reference to the arbitrary axes. Of course this expression, and method of getting $S_0$, is quite well known, not novel as Herr Duncker seems to think.